

THE RESPONSIBILITIES OF RESEARCH DIRECTORS

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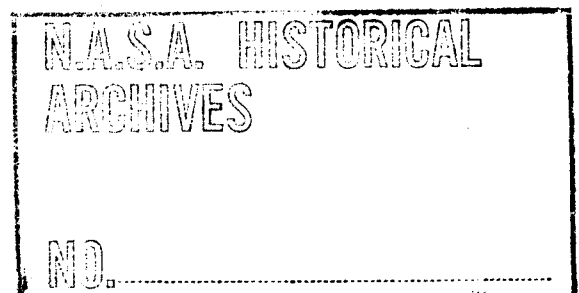
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THE TEAM OF RESEARCH DIRECTORS

In any organization in which the research function is separated from other functions we usually find an individual with the title of director of research or its equivalent. Yet the wise direction of the research work of the organization is a task not of a single individual but of many at various organizational levels with such titles as division head, section head, project leader, etc. As in other complex task, the task to be manageable is subdivided into smaller and smaller units until the research project and its leader are reached. We thus have a whole team of research directors, division and section heads, and project leaders, with whose responsibilities we shall be concerned in this talk. The term research director will be used to include all members of the team.

I will use my own organization, the National Advisory Committee for Aeronautics, as an example. It is instructive to consider the subdivision of areas of responsibility as



analogous to the usual subdivision of geographical areas, which proceeds from the nation to the state to the county to the township to the farm. Each subdivision is successively of smaller size and the number of units increases as the size is reduced. Corresponding to the nation we have the NACA as a whole which has the task of "studying the scientific problems of flight with a view to their practical solution," i.e. the whole field of basic aeronautical research. The responsibility for direction at this level is carried by the Director, NACA. Corresponding to the states, the whole area of aeronautical research is subdivided into aerodynamics, structures, propulsion systems, etc. and in the case of NACA assigned to one of several laboratories. These laboratories are headed by a Laboratory Director who is usually assisted by a chief of research. At the next level of subdivision corresponding to the county we find aerodynamic research, for example, subdivided into research on stability and control, compressible flow, flight, etc. with corresponding divisions with division heads. The divisions are subdivided into sections with section heads corresponding to the division of a county into townships. The smallest unit is the project, corresponding to the farm. This is the unit in closest touch with the conduct of research, and the project leader carries a large responsibility in the total research task.

To some scientists the term research director is self-contradictory since in their opinion any activity which can be directed is not research. Such a narrow view ignores the many contributions to new knowledge made possible by the organized pooling of the knowledge and skills of many scientists striving in a common task. The results not only could not have been accomplished by any single individual but in detail are beyond the knowledge of any single individual. Society is no longer willing to entrust scientific advancement to the haphazard play of the interests of a few individuals or to limit it to the capacity of a single brain. The great task of the team of research directors is to channel the interests and efforts of scientists toward socially desirable goals while preserving that environment of intellectual stimulation and freedom which makes scientific research possible. A prosaic part of this task is the provision of the necessary facilities and funds and the dissemination of the results.

DUAL RESPONSIBILITY AND DILEMMA OF THE RESEARCH DIRECTOR

The task of the research director is a dual one, including both technical and administrative aspects. This fact has led to much unnecessary controversy as to the requisite qualifications, as to whether the research director should be a scientist or an administrator. No one person usually has

formal training in both fields. I am convinced that this question has no universal answer. There are many good scientists who have such little talent for administration that their appointment in any supervisory position would be unfortunate both for them and for their organization. There are many good administrators whose knowledge of the ways of science is so limited that their appointment would wreck the scientific morale of the staff and impair the scientific output which is the reason for existence of the organization. The good research director must either be a scientist who has native or acquired administrative ability or an administrator who has acquired by study or long association a knowledge of science and of the ways of scientists. Naturally because of my own background I believe that, other things being equal, it is best for a research agency to be headed by a scientist. With either solution, the research director should supplement his own skill by that of persons trained in the other field.

The relative technical and administrative responsibilities change greatly as one proceeds through the several organizational levels. At the level of the project leader, technical responsibilities are predominant and administrative functions are relatively minor. At the level of the director of research of a large organization, administrative tasks occupy a great deal of time and effort and the director of research can hardly hope to remain personally a productive research

scientist. His scientific hopes must be realized through the work of others. At intermediate levels the emphasis gradually changes from technical to administrative matters. At all levels however both types of duties are present in varying degree. The dilemma of the research director at all levels arises from the conflicting claims of technical and administrative matters.

TECHNICAL RESPONSIBILITIES

Let us then consider in detail the responsibilities of the research director. In outline, his duties include on the technical side planning, execution, review (supervision), liaison and on the administrative side budget preparation, personnel questions, facilities, reports, scheduling, checking rate of progress, and public relations and "selling."

Technical Planning. - At all levels the research director must determine and state the technical objectives of the work. In this decision as to what the organizational unit will seek to accomplish, he will of course seek and weigh the advice of his staff and of outside groups. The objective of a particular project may be merely the search for understanding in a given area; the objective of a division may be to provide basic design data in a given field. There are innumerable objectives of research effort and the first duty of a research director is to choose the technical objectives of his unit,

translating general directives from higher organizational levels into specific objectives.

The next element in technical planning is to determine the scope of the work to be undertaken. An exploratory survey of a wide area may be undertaken covering a large range of variables or one may fix limits determined by the current situation in a field of technical development for the purpose of more detailed survey. In some cases the scope may be quite narrow. In general as one approaches the individual research project, the scope narrows but even here it is desirable to make a decision at an early stage as to the area to be covered.

The next step is to analyze the methods of approach to be used by the research group. Can the objective be obtained by a purely pencil and paper study by mathematicians or scientists skilled in theoretical methods or is experimental work necessary? If experiments are required, what is the best procedure to accomplish the desired objective? In aeronautical research, for example, should wind tunnel or flight tests be used? Such decisions are required, before an intelligent assignment of responsibility can be made to the units who will do the work. Even at the project level, the particular scientists whom one tries to interest in the problem are determined by planning of this type.

The next consideration in technical planning is facilities. What are the facilities needed to undertake the attack on the

problem by the selected method? What facilities are available? Can the job be done with available facilities? These are the types of technical questions which must be answered by the research director in the technical planning. If he is able and forward looking, his planning of facilities will be related to the progress of the science as well as to the projects immediately at hand. Facilities must often be invented and created in scientific research: they can not always be bought off the shelf by a purchasing agent when needed. Their creation may involve considerable scientific research, -- witness cyclotrons, atomic reactors, supersonic wind tunnels.

The research director is now ready with his staff to plan the general nature of the attack which will actually be made. This will still be in rather broad terms, -- a theoretical group is to consider certain problems, a second group another set, an experimental group with certain equipment will attempt an experimental determination of the optimum values of these quantities. When these results are available, the specific attack on the problem will be made by this selected research team, constituted thus and so under the leadership of this project leader.

An important question is the units of assignment of responsibility. Some jobs can be entrusted to one man, others must be given to a team of specialists in different

disciplines, whereas others can be assigned to an organizational group. The great success of organized planning in manufacturing operations and in developing equipment is well recognized. The adaptation of such methods to applied research has brought great returns and their applicability to pure research is just beginning to be recognized. In such an organization there is room for each scientist to be assigned areas of responsibility appropriate to his intellectual power.

Technical Execution. - Besides his responsibilities for planning the director of research has the duty of arranging for the execution of the plans. Except at the level of the individual research scientist this duty involves the delegation of responsibilities for various aspects of the technical work to other units or members of the agency. The successful research director develops the fullest capabilities of his staff by imposing responsibilities which broaden their experience, and does not reserve all powers of decision on details. Only matters of major importance should need to be referred to him for decision. The execution of the technical work will make demands on his time for training and instruction and for giving professional advice.

Technical Review. - The research work of his group must be continually reviewed by the director. This technical supervision can be best exercised by one competent in the

specific technical field and is of a different character than administrative supervision. The questions to be considered relate first to the technical adequacy of the work. Do the results have meaning from a technical point of view, are the conclusions supported by the data, is previous work in the same field being considered, is the work being competently performed as judged by the results obtained to date? Next, does the work conform to the general policies of the organization? Not that scientific work should be censored by management, either technical or administrative, but there are usually policy questions to be considered. In my own organization, laboratory and division heads must consider whether work proposed or conducted in exploratory fashion by individual staff members falls within the general field of assignment of the laboratory or division and must consider such general policies as that NACA does not itself undertake the development of specific aircraft or missiles and that NACA does not use its facilities in cooperating in such developments when the work can be done elsewhere.

A further responsibility as regards technical review is to assess whether the objective has been or is likely to be accomplished? Every scientific investigation, even the most free studies of basic science, has some objective. In this assessment due weight should be given to the views of the

scientists conducting the theoretical and experimental work, but it is the director's responsibility to discontinue work which does not have some promise of meeting the objective. I agree that the nation might profitably subsidize the scientific activities of a few men of demonstrated ability and leave to their individual judgment the decisions of the type mentioned. Such men would be their own directors of research. I question whether any problem involving team attack can be handled in this way. Certainly, if the research director can actively participate in the theoretical and experimental work, he should, but such participation is not usually practical in any large research organization.

Technical Liaison. - The final technical responsibility of the research director is that for technical liaison, for coordinating, reporting, and exchanging information between staff members within the agency and between his agency and other research agencies. I do not believe this subject needs any extended discussion at this point.

ADMINISTRATIVE RESPONSIBILITIES

The research director is expected to be a good administrator as well as a good scientist; whether he fulfills the expectation or not he cannot escape a heavy burden of administrative as well as technical responsibility. These responsibilities relate to funds, personnel, facilities, progress

reports, priorities, schedules, and public relations.

The availability of funds to pay salaries and to procure supplies and equipment is often taken for granted by the scientist who is not familiar with the effort and skill required to obtain them. The preparation of budget estimates and their support before the agencies responsible for the allocation of funds is a most important task. Unless a relation of mutual confidence can be established, the financial support is likely to be erratic or subjected to such restrictive controls that the morale of the scientific staff is undermined and the progress of the scientific work jeopardized.

At all organizational levels research directors must give much attention to personnel matters, recruitment, promotion, estimates of efficiency, and all those questions generally grouped under the heading of personnel management. Even scientists possess all the virtues and faults of other types of workers. Fair dealing, respect for human personality, and recognition of good work are essential to the health of the agency and prerequisite to good morale and to high technical accomplishment.

The provision and use of facilities present many purely administrative problems. Following a purely technical forecast of what is needed, there is still much organized effort required to prepare more detailed estimates of needs, to locate sources of supply, to order the articles needed, and to

have them available when needed. In many cases the use of facilities must be scheduled in accordance with the needs of various groups. While much of this responsibility can be delegated to staff assistants, the ultimate responsibility is carried by the research director.

While regarded by the research scientist as a useless type of activity, some minimum amount of administrative reporting of progress on assignments is essential to the smooth functioning of a research group. A periodic stock-taking is valuable to the individual worker, and this procedure does not need to attempt the impossible task of predicting the future by attempting to estimate the percentage completion. As has been well said, if the percentage completion can be estimated, the task is not research. The progress report need only be a factual report of the work accomplished, a brief historical record, and hence should not require an undue amount of effort.

The research director often has to deal with priorities or scheduling as an administrative matter. Priorities may of course be related to and involve technical decisions, but often because of limited funds, facilities, or manpower administrative decisions may have to be made as to what work will be undertaken first and as to how other work will be scheduled.

Administrative questions will arise in connection with the rate of progress, which are related to schedules and priorities. Deadlines may have to be set for completing certain work and met by assignment of additional personnel or

by revision of schedules and priorities. As a simple example, papers to be presented at meetings of technical societies must be in hand by a definite date. Similarly, an imminent design competition of the military services may require the analysis and presentation of all pertinent research data or even the completion of specific parts of a research program by a certain date. The administrative decision as to whether the results obtained warrant early presentation to the designer of equipment is often a difficult one.

Finally the director of research has certain duties which are kin to those of the sales departments and public relations departments of commercial firms. The program and its results must be "sold" to many groups, the supplier of funds, the technical design group or other user group of the results of the research, often to the general public. This is true not only in the direction of industrial or applied research but also equally in the purest of pure sciences. The user group may be only the fellow members of a limited professional group and the scientist may be his own research director, but unless this group as well as the individual scientist is sold on the competence and merit of the work, support will suffer. In this extreme case and in others, the sales effort may be merely a clear and excellent presentation of a scientific paper.

THE FOUR-WAY PERSONAL RELATIONSHIPS

As previously noted, the relative emphasis on the

many component duties of the research director varies greatly with the organizational level at which he operates. Let us now look at the research director in action. What specifically does he do to meet these manifold responsibilities?

Unless he is the research director of the agency or one of the active members of a project team, our director is observed to be involved in a four-way personal relationship; he takes some actions directed toward his own supervisor and others directed toward staff members whose activities he himself supervises and reciprocally he stands in the same relation to his supervisor as his own supervised staff stands in relation to him. In other words, there is a flow of service to and from him up and down the line.

Moreover, in addition to the line or vertical relationships there are staff or horizontal relationships between the research director and other groups and individuals within his own agency and between the research director and groups and individuals in other organizations. These relationships which involve both technical and administrative aspects, can best be clarified by more specific discussion.

Relation to Supervisor. - We may expect to see the research director give expert technical advice on matters within the field of competence of his group to his own supervisor, to propose methods and procedures for carrying on the tasks assigned to his group, to write technical reports intended for various types of audiences as required, and to request technical assistance when needed. On the administrative side, we expect to find him presenting estimates of the

funds, facilities, and personnel required to carry on the work assigned to him, recommending promotions, transfers, dismissals, and other personnel actions, reporting operating data and making administrative reports.

Relation to Supervised. - Looking in the other direction along the line organization, we expect to see the research director giving general program directives to the group under his supervision. He will be approving methods and procedures as suggested by the group or as amended after discussion. He will review technical reports and the work accomplished by his group, and he will instruct, advise, and supply technical data as required. On the administrative side he will allocate funds, facilities, and personnel to the units and programs under his direction, he will approve or review personnel actions, and he will request the preparation of such reports and data as may be needed by himself and by his own supervisors.

Relations with Internal Groups. - Coordination and liaison with internal staff and operating groups is an important activity of the research director. Interchange of the necessary information is in many cases accomplished by an interchange of written reports or memoranda, but such interchange is made much less effective by the great volume of such papers in a large organization. Personal conferences and committee discussions are useful tools and formal presentations

of programs and recently obtained results are sometimes justified in a large organization to keep other staff members informed. If not carefully planned and carried out, conference and committee work can waste a great deal of time. Personal contacts are however much more effective than voluminous reports which are not read.

In administrative as well as technical matters, the research director must carry on some informational activities to acquaint other members of the organization with the administrative aspects of the work of his group. In some instances joint approval and joint action may be required, but good administration requires that the number of approvals be small. There is a current story that over a hundred signatures are required to bring a letter to the desk of a certain high government official for signature. The remedy for such a situation is to require no more than a half dozen signatures on the action copy and circulate as many information copies as are really required.

Relations with External Groups. - It is equally important for the research director to cultivate collaboration and exchange with such groups outside his agency as professional societies, university groups, and industry groups in the professional fields in which the agency is working or to whose activities the work of the agency contributes. It is

desirable to hold periodic "open house" inspections for the non-technical clientele of the agency and special technical conferences for the technical clientele. Papers should be presented, when feasible, at meetings of technical societies. Exchange of staff members for short periods is sometimes possible as well as visits planned to explore current activities in a particular area.

INDIVIDUAL GROWTH AND DEVELOPMENT

Besides his many relationships with supervisor and supervised and with other persons in and outside the agency, the research director is expected to keep somewhat current with technical developments and general business, economic, political, and cultural developments as well. Much of this personal development will come from the activities already described but some specific and planned reading and study are usually a necessary supplement. Some technical journals and current news publications must at least be scanned. While a busy research director may find little time for personal experimental or theoretical research, it is advisable for him to accept a few speaking or writing engagements which he himself prepares without the aid of ghost writers. In this way he may find the incentive to exercise his intellectual faculties and hence on occasion to think as well as act.

LEADERSHIP, THE MOST IMPORTANT RESPONSIBILITY OF ALL

I have already mentioned the contradiction implied in the term research director as related to research conducted by individual scientists. A good project director is in reality the leader of the project and the most important responsibility of the research director is to provide leadership. Leadership is more easily recognized than defined or described. A leader is able by the force of his own personality and interest to inspire and create interest on the part of others. He is able to weld a collection of individuals with varying backgrounds, skills, and interests into a team enthusiastically pursuing a common goal. He does this in part by stating challenging tasks of difficulty appropriate to the skill of the team-member, by giving credit and expressing appreciation for good work, by making wise and prompt decisions, by removing bottle-necks to the progress of the work, by creating a favorable physical and intellectual environment, thus promoting morale. The leader commands the respect of his associates and in turn respects the knowledge, skills, and ambitions of his associates. He regards them as persons, and not as bodies or machine units. Such is the ideal way in which research should be "directed."

CONCLUSION

The long list of responsibilities described suggests an

overwhelming burden, too great to be borne by any one person. This impression is created by the attempt to describe in some detail in words the many facets of this interesting occupation. To describe in detail such a common task as walking requires a great many words, and a complete description would suggest that no one could perform such a complicated task as walking, to make the necessary motions of the feet, to preserve balance, and to maintain motion in a straight line. But most persons walk and many persons cope fairly well with the responsibilities of directing research. It is hoped that this brief discussion will help them to do a still better job.